

National Aeronautics and Space Administration  
Commercial Space Committee  
of the  
NASA Advisory Council

September 18, 2012  
NASA Ames Research Center  
Moffett Field, California

Meeting Minutes

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Thomas W. Rathjen  
Executive Secretary  
Commercial Space Committee

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Patti Grace Smith  
Chair  
Commercial Space Committee

*Meeting report prepared by  
Elizabeth Sheley*

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## Proceedings

### *Members present*

Ms. Patti Grace Smith, *Chair*  
Dr. Bernard A. Harris, Jr.  
Mr. Lon Levin (via telecom)  
Mr. Stephen S. Oswald  
Ms. Franceska O. Schroder  
Mr. Wilbur C. Trafton  
Mr. Thomas W. Rathjen, *Executive Secretary*  
Ms. Shawanda Robinson, *Administrative Officer*

### **Call to Order and Opening Remarks**

Thomas Rathjen, Executive Secretary of the NASA Advisory Committee (NAC) Commercial Space Committee (CSC), welcomed those present. He noted that the agenda provided time for public comments at the end of the day.

Next, Patti Grace Smith, Chair of CSC, welcomed the CSC members and other participants, and thanked the staff from the Ames Research Center and NASA for arranging the meeting.

### **Assessment of Commercial Suborbital Market**

Ms. Smith introduced Carissa Christensen, Managing Partner from The Tauri Group, which is a well-established data analysis firm with significant experience in the area of commercial space.

Ms. Christensen described a Tauri Group study about suborbital reusable vehicles (SRVs) that reflects the challenges of forecast and market predictions. SRVs are creating a new spaceflight industry. The challenge is to understand all the elements involved, along with their impact and magnitude. The SRV forecast project was funded jointly by the Federal Aviation Administration (FAA) and Space Florida, which is Florida's aerospace economic development agency.

SRVs both launch and return, making them substantially reusable. They have periods of microgravity, and most are quite small, with a top cargo capacity of about 700 kg. These vehicles may launch very small satellites. Those that are planned to carry people will have ticket prices between \$95,000 and \$200,000 for one to six passengers.

Six companies are actively developing SRVs:

- UP Aerospace
- Armadillo Aerospace
- XCOR Aerospace
- Virgin Galactic
- Masten Space Systems

- Blue Origin

Several of these companies have plans to make multiple vehicles, and there is a lot of variation among them.

The objective of the Tauri Group forecast was to provide insight into the drivers of potential outcomes for SRVs and to identify those outcomes to the extent possible, leading to a projection of market dynamics. The project involved multiple interviews conducted with many potential stakeholders. The eight potential markets examined are:

- Commercial human space flight
- Basic and applied research
- Aerospace technology test and demonstration
- Media and public relations
- Education
- Satellite deployment
- Remote sensing
- Point to point transportation

The baseline scenario for the study was that SRVs operate in a predictable political and economic environment that is relatively similar to the current one. Existing trends generate demand. The growth scenario assumed new dynamics emerging from marketing, branding, and research successes, while the constrained scenario was based on dramatically reduced spending due to poor economic conditions and the like. The core assumptions across scenarios included stable prices and the perception of safe operations.

The **commercial human spaceflight segment** is expected to account for 80 percent of the demand. The forecast determined that there are about 8,000 people who would be interested, willing, and able to pay for a suborbital flight. Most of these are the very wealthy, with net assets of \$5 million or more, a background of having spent at least \$50,000 on travel and leisure activities, and a willingness to spend \$100,000 or more on such activities. Not all of the individuals in this segment would be flying right away; the forecast came up with a baseline of 3,600 people to fly over the next 10 years. The forecast also included a much smaller commercial market comprising individuals who are highly enthusiastic about spaceflight but less wealthy. This “space enthusiast population” is small, equal to about 5 percent of the very wealthy.

Of the SRVs currently in development, four will be capable of carrying humans. The three that are currently taking flight reservations have a total of about 925 paid reservations to date; more than half of those are with Virgin Galactic. Until there are actual SRV flights, it is difficult to predict reactions to the experience, but those are sure to affect reservation sales. The survey also found that while there is growth potential in reducing prices, an increase in the projected prices reduces demand by relatively little.

There has been much discussion about the **basic and applied research segment**. The fundamental question is: What can be done with 3-5 minutes of microgravity? The Tauri Group identified four areas in which SRVs would offer unique capabilities for this segment:

- Atmospheric research
- Suborbital astronomy
- Longitudinal human research
- Microgravity

The study assumed the current level of funding, though with some shifts in priorities. There are some strong pockets of microgravity interest in the U.S. budget, but not much funding. However, there may be some commercial interest from pharmaceutical companies and others. This is not likely to be a massive market, but it does show some potential and might include some non-U.S. organizations or companies. The study identified about 50 firms as likely candidates.

The **aerospace technology test and demonstration segment** has potential to advance technology maturity or achieve space demonstration, qualification, and certification. The study determined potential for modest growth in this area, in part because there is not much demand. Nor do NASA or the Department of Defense (DoD) demonstrate a clear view of how SRVs would fit into their programs. The **satellite deployment segment** is also small. SRVs could be price- and capability-competitive for very small satellites weighing 15 kg or less, but the market is constrained due to the likelihood that DoD will probably want its own vehicles.

Ms. Christensen referred to the **education segment** as “the bake sale market” of non-government-funded payloads costing schools about \$5,000. Schools launch rockets every year for a variety of reasons, such as robotics competitions. SRVs are attractive to schools because the payload can launch and return every semester. Universities could move into this area easily. In addition, there is a long history of including teachers on parabolic flights. Although demand in both the payload and teacher markets is likely to increase, growth will be driven by payloads.

The **media and public relations segment** is difficult to predict. It is unlikely that this group, which includes entertainment, will use SRVs to achieve the effects of space, which are now done in special effects studios. Documentaries are possibilities, however, and there has been interest on the part of reality shows and contests. This would account for a modest number of launches.

Major uncertainties include the following:

- Consumer behavior, since no one has done this before;
- Commercial interest by industry;
- Changeable perceptions and the impact on media and public relations. If a major celebrity goes up and enjoys the experience, that is good, but if he or she hates it, there could be some negative effects;
- Research by U.S. agencies that do not traditionally fund space research, as this would likely be slow to be taken up;
- International government programs; and,
- NASA and DoD, which could be larger than predicted.

## **Discussion**

In response to a question about the financial investment community, Ms. Christensen explained that there is interest but little penetration. The vast majority of the demand is from the private sector. The baseline is 400-500 seats per year, with growth up to 1,500 seats annually. Some of this demand will occur even in a financially constrained environment. The huge uncertainty is on actual uptake. Demand could take off and flatten or start slow and build. The forecast is for a peak annual flight revenue of \$200 million, but that is not a certainty. As to whether this is enough to launch an industry, Ms. Christensen said the \$200 million should be seen in context of the space industry, and the companies involved are saying that the demand is greater than the forecast.

Stephen Oswald noted that the margins are important. He assumes that there will be some “bad days,” and asked Ms. Christensen how she accounted for that. She replied that safety is a concern of everyone involved, as there are few data and many questions. In the absence of data, people come to conclusions like an accident would shut down industry, for example. However, many industries deal with risk and uncertainty. The question deserves study. Mr. Oswald said that he thinks the market will fly through it, but he is interested in the perception that people will have when they come back. What if they become sick? Or rave about the view? There will be some of both. Ms. Christensen noted that 84 percent of the respondents said they cared about the view, and 65 percent mentioned weightlessness. About half want to be able to say they have done it. There are many reasons why people may be interested. Virgin Galactic has been working to shape perceptions for the adventure market, for example, which is different from the space image.

Other research topics that might be considered compelling as a result of the study include safety and how NASA can use and benefit from SRVs. Regarding the possibilities of orbital tourism, the market dynamics are more traditional, with a much smaller population. An ongoing DoD study indicates that the emergence of SRVs may change how we think of the space industrial race. As for those potential travelers who might want something of longer duration, about 20 percent of those who said they were not interested gave the reason as being insufficient time. However, the study did not ask about the tipping point. The industrial base reacted with interest. The Tauri Group came away with the idea of energizing a researcher community.

## **Overview of Commercial Crew Integrated Capability Agreements**

Ed Mango, Commercial Crew Program Manager, reviewed the content of the three Commercial Crew Integrated Capability (CCiCap) Space Act Agreements (SAAs), and also presented the Program’s latest plans for certification. NASA awarded CCiCap SAAs to three partners, creating a competitive portfolio of companies. They are making significant progress with additional integrated system design, hardware testing, and development. The SAA base period and optional milestones provide insight into the cost and schedule required to achieve a crewed demonstration flight to LEO.

**Sierra Nevada Corporation** is developing the Dream Chaser. This reusable, piloted spacecraft carries seven crew, uses nontoxic propellants, will operate out of Cape Canaveral, and has abort engines that perform other mission propulsion functions if a launch does not abort. Sierra's plan is to use an Atlas V launch vehicle. Mr. Mango reviewed the key milestones for the base period, including design and testing development plans. Sierra can collect \$212.5 million from NASA for meeting its nine base period milestones. The company will make significant progress toward completion of critical design under CCIcap. Two major safety review milestones are in the plan.

The **Space Exploration Technologies Corporation (SpaceX)** is working on a crewed version of the SpaceX Dragon capsule, which will launch from Cape Canaveral and land in the West at a yet-to-be-determined location. The capsule will carry up to seven crew members and will have a side-mounted launch abort system. Their plan is to upgrade the Falcon 9 launch vehicle and launch a crewed mission in 2015. NASA will fund \$440 million for successfully meeting the 14 CCIcap base period milestones. Mr. Mango reviewed the key milestones.

For its CST-100 spacecraft, **Boeing** is designing a reusable capsule that will include many proven flight components. Like the other two partners, Boeing anticipates up to seven crew members and a primary launch site of Cape Canaveral. The CST-100 will land on land at a to-be-determined location in the West, and will use the Atlas V launch vehicle for at least initial missions. Their schedule plans a crewed test flight in 2016. The company will receive \$460 million from NASA for achieving its 19 base period CCIcap milestones. Mr. Mango reviewed the key milestones for Boeing.

NASA let the companies propose the milestones and their value, which is reflected in the criteria and payments. In working with the three partners, NASA brings both funding and technical expertise. Commercial Crew Program teams are working with the companies almost continuously, and there have been many technical interchange meetings.

Brent Jett, Deputy Program Manager for the Commercial Crew Program, discussed the certification strategy for crewed transportation of NASA crews to the International Space Station (ISS). Phase 1 of the certification effort is a small contract, the Certification Products Contract (CPC), that allows NASA to discuss with industry the variances or exceptions that companies might have with respect to the NASA requirements. NASA funds no development work through this contract, only the four initial certification products included in this phase 1 contract. The CPC allows for technical interchanges between NASA and the contractors on certification requirements. The products are: alternate standards; hazard analyses/reports; verification and validation plan; and certification plan. It is important that the companies identify hazards early in the design in order to eliminate or mitigate them. NASA will learn where variances or exceptions are needed through the verification and validation plan. The CPC request for proposal was released on September 12<sup>th</sup>. NASA expects to award two to four contracts, valued at no more than \$10 million each.

Based on Phase 1 results – or competitive work done outside of CPC at a company's expense– NASA will select one or two contractors to keep going to certification phase 2. The Program expects the phase 2 certification contract to have at least one crewed mission and a number of options for additional crewed flights to the ISS if needed.

Mr. Mango added that the CCIcap SAAs and the certification efforts are intertwined from the Program standpoint but kept separate for the commercial companies. In answer to a question, Mr. Jett said that he is not sure if any organization other than the three CCIcap partners is involved in continuing development of a LEO commercial crew transportation capability. The pre-proposal conference for CPC was scheduled for the next day with as many as eight companies registered, but he did not know which plan to submit a proposal and which might be merely networking.

### **Ames Research Center's Commercial Space Activities and Plans**

Dr. Simon P. Worden, Center Director for Ames Research Center, discussed the role of Ames in NASA's history. Ames operates in the spirit of Silicon Valley, spinning off inventions and birthing new industries like biotech and cybertech. NASA inherited Ames from the National Advisory Committee on Aeronautics (NACA), NASA's predecessor. The Center hosts over 100 organizations on its campus, from companies to universities to small groups, all doing interesting things with the sole requirement that the activities must in some way be relevant to NASA and its missions. Some ventures spin off into areas not related to NASA, with the resulting companies occasionally hiring NASA staff or contractors.

Moffett Field, where Ames is located, was once a lead field for airships, though the technology was abandoned after some spectacular crashes. That left behind the huge hangar at Ames, which is being refaced and could house the start of new industries. At least one group has expressed interest in the refurbished hangar, and Ames is now discussing how to lease it to them. Dr. Worden hopes that a major new aeronautics industry will result. Airships are now used mostly for tourism, but there are efforts to apply the technology to situations requiring heavy-lift capabilities where there is little or no infrastructure or refueling capacity. An example is in Alaska, where about 30 percent of the population does not live on a road. Climate change has reduced the number of days Alaskans can use ice roads, creating a need for efficient, low-altitude aircraft that can function in bad weather. The airships are actually more efficient in cold weather.

Other projects include the New Worlds Imager, which employs external occulters to help detect life-bearing planets. IT is another area of innovation; Dr. Worden described a thriving company that was created at Ames and moved outside because the Federal government was slow to pick it up. There was also an instance in which an airplane that was meant for Mars travel was cancelled, but the company went on to repurpose itself and now provides affordable energy for sustainable buildings.

A company called H211 has grown out of Google and hopes to use the airship hangar for a proprietary project. Ames signed a Space Act Agreement (SAA) stating that the company's aircraft could stay at NASA provided they can use it for research purposes. NASA has done



about 60 sorties for earth science projects with this vehicle. Another project growing out of Google may lead to the world's biggest quantum computer. With NASA's participation, Google has also established a competition involving 20-30 teams worldwide, with the possible outcome of using the vehicle to carry plants to the moon.

Virtually every atmospheric entry system that the United States has ever developed has a significant legacy from Ames. Dr. Worden described two-way technology transfers with SpaceX, which may lead to a reduction in costs for future Mars missions. He believes that the next revolution is in biotech, and suggested that DNA development and knowledge may be useful on a crewed trip to Mars. Ames has signed an SAA with Craig Venter's new firm to support research in this area. There is also a synthetic biology initiative at Ames that promotes a vision of how to live on another planet. It is very important to bring in students. They love competitions. Last year, the Stanford-Brown team produced biobricks with the strength of concrete, using urine and water. Another group did 3-D printing that can be done in space; they may get a major contract.

### *Discussion*

Dr. Bernard Harris asked if Ames currently manages the old naval base. Dr. Worden said that it does. There is pressure to get excess land off the books, so the General Services Administration (GSA) will lease it. However, the airfield has to remain an airfield. The Federal Emergency Management Agency (FEMA) uses it for emergency response, as does the Air Force. In response to a question, Dr. Worden said that the waiting list to work at Ames is long. When the Center opens new buildings, it gets interest from 20-30 groups, and existing groups want more space. It is part of the synergy between NASA and Silicon Valley.

Lon Levin asked if, were this to be done all over again, Ames truly belongs under NASA and whether it should be a Federally Funded Research and Development Center (FFRDC) at this point? Dr. Worden replied that Ames is research lab and NASA needs that. This particular research center is "a bit further out" than the others, but Ames or something like it belongs in NASA, and therefore he thought that Ames should stay at NASA. As to whether the current management structure is ideal, he noted that a lot of Ames's work is for other agencies, like DoD, and the Center has a growing private sector portfolio. It creates an interesting question, because the issue becomes whether or not an FFRDC makes it easier to do the non-NASA work. A key appeal of Ames is the NASA logo, however.

Wilbur Trafton asked what keeps him up at night. Dr. Worden answered that it is tough to be out on the edge while working in the U.S. government, because there is a need to be careful and stay within the legal and regulatory bounds. Another concern is employee satisfaction. The Center is always at bottom of surveys with that. Silicon Valley is an expensive area in which to live, so most civil servants at Ames are making the maximum possible salaries. With the highest percentage of PhDs of any unit within the Agency, he is not surprised they are disgruntled. Yet there are positives to being a civil service center. He is pretty excited about what he has and NASA is a pretty good agency with which to work. He would happily take more resources, but overall it is a good situation, and he would not change it much beyond some small issues.

## **Dryden Flight Research Center's Commercial Space Activities and Plans**

David McBride, Director of the Dryden Flight Research Center (DFRC), presented an overview of DFRC activities. Mr. McBride reviewed a few of the Center's early programs that led to the Space Shuttle. DFRC works with some of the commercial space partners, like Sierra Nevada, Boeing, SpaceX, and others, while also doing some science work for NASA's Science Mission Directorate (SMD). The Center's mission is advancing technology and science through flight. Dryden's location is unique, with excellent weather, topology, and 68 miles of lakebed runways. Dryden is a tenant of Edwards Air Force base and, as such, has great access to base resources. This allows DFRC to do work it could not otherwise afford.

Most DFRC funding now is from science, but the majority of the workforce supports aeronautics research. The Center has 23 aircraft types, and while some of its aircraft are old, they are operated at the edge of their capabilities. Mr. McBride gave the example of the Aeronautics Research Mission Directorate (ARMD) Integrated Systems Research Program (ISRP) X-48B/C project, which is the future of aviation, as it reduces fuel burn substantially.

In airborne science, DFRC does calibration and validation, and in the climate area, the Center provides the aircraft that support the science campaigns. DFRC does not conduct science as such, but makes it possible by running the flight aspect of science campaigns. Mr. McBride gave some examples regarding tornadoes in the Midwest, ice flows in Antarctica, and more. Another example of DFRC coordination with SMD is the Stratospheric Observatory for Infrared Astronomy (SOFIA), operated with the Astrophysics Division (APD) and the German Aerospace Center. SOFIA helps fill the gap between what can be detected with ground-based telescopes and what can be seen with orbiting telescopes. The aircraft has recently been upgraded with a new pressure bulkhead for the telescope. SOFIA allows scientists the opportunity to go on board with their instruments, and has an active teachers-in-space program.

While people think of DFRC as an aeronautics center, many of its technologies and skills go back to spacecraft research test programs. Dryden brings together all of the flight elements and has a long legacy of rocket flight. The Center helped validate the Space Shuttle program technology, then supported it for 30 years. Forty percent of all the Shuttle operations ended up landing at Dryden.

DFRC has many activities relevant to the Agency's commercial space strategy. For example, DFRC is providing some services to the Sierra Nevada Dream Chaser Program. The Center also collaborates with Edwards Air Force Base on occasion. This is all reimbursable work, with no NASA funding. With the Dream Chaser, DFRC will help validate the launch abort system, and is talking with Sierra Nevada about next steps.

Dryden's current activities to promote commercial space revolve around its status as the leading provider of commercial suborbital launches and payload development. The transitioning from the Shuttle and Constellation toward commercial space activities is almost complete, with dispositioning of the Shuttle assets scheduled to be concluded by

March 2013 and a new emphasis on commercial space activities. The 747s are going to be decommissioned and their parts may be used to support SOFIA. In the Human Exploration realm, Mr. McBride would like to see DFRC become active with launch abort systems, flight simulations, commercial crew, recovery of payloads, recovery of capsules, and alternative launch concepts. Right now, there is no excess capacity at Dryden. Development programs often use up funds before a concept gets to flight, which can be an issue.

### **Jet Propulsion Laboratory's Commercial Space Activities and Plans**

Lt. Gen. Eugene Tattini, Deputy Center Director of the Jet Propulsion Laboratory (JPL), described the Lab's commercial space activities. JPL's budget comes almost entirely from the space science sector of NASA. The Lab is a division of the California Institute of Technology (Caltech), but its facilities are owned by the Federal government. About 70 percent of the 4,900 people who work at JPL are directly associated with Research and Development (R&D). It is a very highly educated workforce.

The JPL mission for NASA emphasizes robotic space exploration in six key areas: Mars, which takes up many resources; solar; exoplanets; astrophysics; Earth science; and the interplanetary network. JPL is responsible for 24 spacecraft and 10 instruments across the solar system and beyond. JPL was also behind the recent successful Mars landing of Curiosity Rover, and has other Mars programs in the pipeline. Another JPL project is the Cassini spacecraft, which has orbited Saturn for 7 years and has thus far detected 52 moons. The Juno spacecraft, which will arrive at Jupiter in 2016, is a product of JPL and Lockheed Martin and has flown the furthest from the sun of any space vehicle relying on solar power. JPL is the only organization that has successfully landed on Mars.

NASA's Earth Science Division (ESD) has relied on JPL to fly many of the Division's oceanographic missions. JPL is currently upgrading the Deep Space Network (DSN) that is critical in implementing some of these missions. JPL provides capabilities across the lifespan of missions, from project formulation to spacecraft development to operations. This capacity helps NASA's commercial efforts by creating a selling point. Gen. Tattini noted that JPL submits an average of 730 proposals each year. He provided an example of a communications partnership, noting that most commercial agreements take the form of SAAs. Caltech gets first rights to intellectual property in some of these cases. For every mission, about 4 percent of the funds are earmarked for education and public outreach, as NASA requires.

The JPL organizational chart shows that the NASA Space Technology Program and the Small Business Innovation Research (SBIR) Program are in their own block. The Human Exploration and Operations (HE&O) Technology Program is small. The Commercial Program encompasses climate, space, medical research, cyber research, robotics, and energy. Robotics and prosthetics includes such areas as artificial sight.

JPL's commercial space strategy centers on active engagement with the commercial sector, outsourcing of a substantial portion of robotic space mission funds to the commercial space industry, and encouragement of entrepreneurial technology development. Being an FFRDC

provides JPL a unique ability to stimulate commercial space activities. About half of the Lab's budget stays at JPL, with the other half going to colleagues in industry.

Mr. Oswald noted that weather satellites and remote sensing have been deemed inherently governmental functions. While he can see that with weather, he was not sure about remote sensing. Gen. Tattini replied that there is a big debate about weather capabilities, and the Federal government is reluctant to let the commercial side manage it. The restraint could be cultural. As for remote sensing, there are Federal programs run by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS), the latter managing the LandSat program. These two concerns are not covered by the commercial space policy, although it would be interesting to explore the possibilities. Franceska Schroder said that this is confusing in light of the fact that commercial weather services are available. It points to an inherent inconsistency.

JPL has active and potential commercial collaboration in the areas of detectors and instruments; power and propulsion; exploration and robotics; modeling and simulation; navigation, GPS, and communications; and other areas such as avionics. NASA's contract administration can sometimes be a bottleneck, but ultimately the work gets done. Some of the commercial applications stemming from JPL-derived technology include digital cameras, cardiac health, fire detection, GPS, and much more.

Gen. Tattini next discussed intellectual property issues. More patents are issued to JPL than the other centers and, similarly, JPL has many more SAAs. Dr. Harris asked if there is a mechanism for the inventor who works for JPL but is a Caltech employee to capture any of the revenue. Gen. Tattini said that there is, but the general sentiment among those inventors is that they do not get enough. JPL will encourage these individuals to take a sabbatical in order to seek venture capital and learn if they will succeed in the marketplace. If they later need to return to JPL, they can. He also noted that JPL has been awarded four NASA Innovative Advanced Concepts (NIAC) grants.

As JPL transitions away from the Shuttle and Constellation programs, it is important to note that the Center is land-locked and has trouble growing without new space. The lack of excess capacity is a problem, because unlike the civil service NASA centers, JPL's status as an FFRDC makes it more difficult to expand.

### **Public Comments**

CSC set aside time in the agenda for public comment. However, no members of the public came forward to speak.

### **Brief Deliberation and Closing Remarks**

Ms. Smith recalled that CSC was tasked this year to visit the Centers and talk to Center Directors, which they have now completed. In November, the Committee will need to pull together its recommendations and findings. Ms. Smith also wants to develop a tentative list of topics to cover in 2013 at the November meeting.

The Committee brainstormed on potential future topics:

Mr. Oswald said that he would like to learn more about weather satellites and remote sensing. Ms. Smith agreed. There have been some substantial proposals to NOAA and discussion about capabilities. Dr. Harris expressed interest in hearing more about how other Centers cover intellectual property, which comes under commercialization. Ms. Schroder advised exploring the use of Cooperative Research and Development Agreements (CRADAs), how and why they do or do not work, and how they might be optimized for commercial space purposes. Ms. Smith wanted to learn more about leasing activities at the Centers, about which there has been conflicting or confusing information. It might be worth looking at science activities, though some of the timelines are long and it is often expensive. However, there might be potential in the area of life sciences. NASA does have several contracts with the National Institutes of Health (NIH). It would be good to learn about the capabilities and potential with NIH and other groups. Another suggestion was to have more information about what other FFRDCs do. There was a report on NASA and FFRDCs issued about 10 years ago.

At the previous meeting, there was discussion about the utility of these meetings. Ms. Smith noted that the NAC has been very positive in reacting to CSC's recommendations and activities.

Mr. Rathjen said that he will send the Committee members a list of potential future topics based on the above discussion, to which they can add further suggestions. It was noted that members might like to hear from Mission Support and NOAA, and it could be interesting to learn about NASA's counterpart in Canada. Ms. Smith said that she looked forward to the November CSC session, and adjourned the meeting.

## **Appendix A, Meeting Agenda**

11:45 a.m.	Call to Order and Opening Remarks
11:55	Assessment of Commercial Suborbital Market
1:15 p.m.	Overview of Commercial Crew Integrated Capability Agreements
2:00	Ames Research Center's Commercial Space Activities and Plans
3:15	Dryden Flight Research Center's Commercial Space Activities and Plans
4:15	Jet Propulsion Laboratory's Commercial Space Activities and Plans
5:20	Brief Deliberation and Closing Remarks
5:30	Adjourn

## **Appendix B, Committee Membership**

Ms. Patti Grace Smith, Chair  
Patti Grace Smith Consulting

Mr. Thomas W. Rathjen, Executive Secretary  
NASA Headquarters

Major General Donald Hard  
U.S. Air Force (retired), independent consultant

Dr. Bernard Harris  
CEO, Vasalius Ventures

Mr. Lon Levin  
Co-founder, XM Satellite Radio and other satellite businesses

Mr. Stephen S. Oswald  
Founder and President, Syzygy Enterprises, LLC

Ms. Francesca O. Schroder  
Principal Attorney, Fish & Richardson

Mr. Wilbur C. Trafton  
President, Will Trafton and Associates